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Journal of the Society of Arts.

FRIDAY, JUNE 7, 1867.

Announcements by the Council.

THE LATE SIR THOMAS PHILLIPS.

At a meeting of the Council on Monday last, the 3rd instant, the following resolutions were passed:—

Resolved—"That the Council desire to record their deep regret at the death of their much esteemed and excellent chairman, Sir Thomas Phillips, whose long and valuable services as a member of this Council, and as its chairman for several years, have largely contributed to promote the interests and usefulness of this Society.

"That a copy of this resolution be sent to Mr. William Page Phillips (nephew of the late chairman), together with the expression of condolence and sympathy of the Council with him and the rest of Sir Thomas Phillips' family."

ANNUAL CONFERENCE.

The Sixteenth Annual Conference between the Council and the Representatives of the Institutions in Union and Local Boards will be held on Wednesday, the 19th June, at Twelve o'clock, noon. The Right Hon. HENRY AUSTIN BRUCE, M.P., will preside.

The Council will lay before the Conference the Secretary's Report of the Proceedings of the Union for the past year, and the Results of the Examinations, and the Programme of Examinations for 1868 will also be considered by the Conference.

The following suggestions of Subjects for Discussion have been received from various quarters, it being understood that in putting them forward the Council express no opinion whatever upon them:—

1. Whether the means at present available for the promotion of Primary Education are sufficient to qualify the working classes to take advantage of the Secondary Instruction offered by Institutes to Adults?

2. Whether provisions should be inserted in the Manchester Education Bill, now before Parliament, which would authorize grants to be made to Evening Schools and Classes?

3. Whether, considering the valuable results of the co-operation which the Royal Horticultural and Geographical Societies, and certain public companies, have afforded to the Society of Arts in extending the sphere of its Examinations, the like co-operation cannot be obtained from other societies and companies, especially from the Royal Agricultural and Botanical Societies?

4. Whether any additional means can be devised to induce the Institutions to form District Unions, with paid Visiting Officers, in connexion with the Society of Arts?

5. Whether additional interest in the Final Examinations might not be excited by the establishment of Special Prize Funds in the District Unions, to which Supplementary District Prizes might be added by the Society of Arts?

6. What means can be adopted by the Local Boards to secure a larger number (a) of Candidates from the Artizan Class at the Final Examinations, and (b) of Female Candidates at the Elementary and Final Examinations?

7. Whether it would be expedient to adopt, as far as possible, one specified text-book for each of the subjects in the Final Examinations?

8. Whether it would be expedient that the Society of Arts should decline to recognize an Elementary Certificate of any given year as a Pass to the Final Examinations of the same year?

9. Whether it is desirable, in the Elementary Examinations, to have one set of papers instead of two, as at present, but with two grades of Certificates, according to the merit of the Candidates?

10. Whether, in order to secure uniformity in the Previous Examinations, the Society of Arts should furnish an Elementary Paper (distinct from the Ordinary Elementary Examinations) to meet the case of those Candidates who may not, in any previous year, have obtained Elementary Certificates?

11. Whether any steps can be taken by the Society of Arts, in order to prevail upon the Science and Art Department to grant Honorary Teachers' Certificates to those gentlemen who shall be recommended by any Public Educational Board?

12. How can the Institutions or District Unions assist the movement now being made by the Society of Arts to send selected Workmen to Examine and Report upon the Paris Exhibition?

Secretaries of Institutions and Local Boards are requested to send, as soon as possible, the names of the Representatives appointed to attend the Conference, and early notice should be given of any other subjects which Institutions or Local Boards may desire their Representatives to introduce to the notice of the Conference.

As the subject of National Education is of peculiar interest at the present time, and several topics of great importance to the Institutions are proposed for discussion at the Conference, the Council hope that each Institution and Local Board will not fail to appoint one or more Representatives to express its views.

Secretaries of Institutions are requested to forward *at once* by book post, copies of the last Annual Reports of their Institutions.

EXAMINATIONS, 1867.

The following corrections should be made in the List of Prizes and Certificates given in last week's *Journal*:—

In Political and Social Economy, the 1st prize of £5 to No. 1473, Edward T. Sims, jun., Southampton Athenæum, clerk. No second prize awarded.

To the note marked (+) add, "or the candidates were disqualified for receiving prizes."

In the List of Certificates, No. 1489, Hadfield, James, should have been described as of the Staleybridge M.I.

ARTIZANS' VISITS TO PARIS.

The Council of the Society of Arts, feeling the importance of promoting the intelligent study of the Paris Exhibition and the manufacturing establishments in France by artisans of the United Kingdom, have appointed a Committee in furtherance of this object, and on their recommendation, have passed the following minute:—

At the last and former International Exhibitions held in this country, arrangements were made by the French Government, to facilitate the visits of skilled artisans, and interesting reports on the exhibitions were made by them to their government. Believing that such visits on the part of skilled workmen to these great international displays not only exercise a beneficial influence upon the men themselves, but also upon the progress of industry in the country to which they belong, the Council of the Society of Arts have resolved to raise a fund to be employed, in aiding a limited number of English workmen to proceed to Paris for the purpose of studying the present French Exhibition.

To carry this object into effect, they have agreed on the following plan:—

1st. That a number of selected workmen (the number to depend on the amount of funds at the disposal of the Council) shall be assisted to proceed to and remain in Paris a sufficient time (say three weeks), for the purpose of making a careful study of the exhibition, and of such factories and workshops as they may desire to visit.

2nd. That every man so assisted shall, on his return, make a report to the Society of what he has observed during his stay, in reference to the special industry in which he is engaged, and that it be made a condition of the grant to each man that one-third of the amount be retained until his report shall be supplied to the Society.

3rd. The Council think it will be undesirable to fix the exact time for, or to prescribe the duration of, these visits, or to interfere with any of the arrangements the men may desire to make for their own accommodation; but, in order that they may take advantage of the facilities provided by the Commission organised by the French Government for the study of the exhibition, the men will be placed in communication with that Commission on their arrival in Paris.

4th. A considerable sum will be required satisfactorily to accomplish the important object undertaken by the Society, and, in order to raise these funds, the Council have determined to appeal to the members of the Society, who must be interested in the successful results of this movement, in the belief that they will not hesitate to join in a subscription for the furtherance of the undertaking; and they propose at the same time to communicate with the various Chambers of Commerce, inviting their counsel and support. The Council have decided to commence the subscription by a vote of one hundred guineas from the funds of the Society.

Members are invited to aid the Council in this undertaking by subscriptions, which should be forwarded to the Financial Officer at the Society's house.

HIS ROYAL HIGHNESS THE PRINCE OF WALES, President of the Society, has presented a donation of Thirty Guineas.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, June 5th, 1867; THOMAS WEBSTER, Esq., Q.C., F.R.S., in the Chair.

The following candidates were proposed for election as members of the Society:—

Asprey, Charles, jun., 166, New Bond-street, W.
Byass, Robert B., Nevill-park, Tunbridge Wells.
Cross, John C., 12, Barnsbury-road, Islington, N.
Edwards, Robert, 35, Lower-street, Deal.
McMillan, John, 7, Westminster-chambers, S.W.
Meeson, Alfred, 5, Westminster-chambers, S.W.
Mounsey, Ewart Simon, 5, Raymond-buildings, Gray's-inn, W.C.
Rossiter, William, F.R.G.S., Linden-villa, Tottenham, N.
Rutherford, Charles, 32, Oakley-road, Southgate-road, N.
Sykes, John, 280, Regent-street, W.

The following candidates were balloted for, and duly elected members of the Society:—

Armit, Lieut.-Col. Louis, R.E., Golden Cross Hotel, Charing-cross, S.W.
Davidson, James, Laboratory Department, Royal Arsenal, Woolwich, S.E.
Lucas, Frederick, 26, Maddox-street, Regent-street, W.
Salvin, Anthony, 4, Adam-street, Adelphi, W.C.
Whitley, Nicholas, Truro, Cornwall.
Williams, Michael, 35, St. James's-place, St. James's-street, S.W.

The Paper read was—

ON THE WATER SUPPLY OF THE METROPOLIS, IN RELATION TO THE CONSERVANCY OF THE THAMES AND ITS TRIBUTARIES, AND THE DEMANDS OF THE WATER COMPANIES.

By J. BAILEY DENTON, Esq.

It may be in the recollection of some of our members that I have on several occasions raised discussion within these walls on the subject of water supply in connection with land drainage, river improvements, and the necessity of an accurate record of rainfall.*

On these and on other occasions I have treated the subject as one of national importance, affecting not the metropolis only, but extending to the whole country, being impressed with the facts, which are daily becoming more generally acknowledged, that the rainfall is getting positively, though gradually, less in quantity, from the disafforesting of woodland, the improved cultivation of the soil, and the drainage of lands and districts; that, although, by the drainage of land, we gain an increase of water in the winter season, we suffer a diminution in summer; and that the sewerage of towns is corrupting our rivers and streams in their transit through the country to the sea, proportionately as the sewerage of towns extends and the summer flow of rivers become less. All these influences are connectedly producing a great change in our water system, demanding the serious attention of the people and the protective care of the Government; and we cannot shut our eyes to the truth that our population is increasing at the rate of 200,000 a year, or 3,845 a week, while the area of our island remains the same.

I have not hitherto laid any great stress upon the diminution of the rainfall, because it has always been considered that the position of Great Britain, in its proximity to the wide Atlantic Ocean—from the surface of which evaporation takes place to an unlimited extent, increased by the warm current of the Gulf stream—is such as to make any diminution of rainfall resulting from re-

* *Journal of the Society of Arts*, December 14th, 1855; January 15th, 1856; and November 24th, 1865.

duced evaporation from the surface of our island a matter of very little moment. The valuable essay of Professor Ansted, recently published in the *Journal of the Royal Agricultural Society of England*,* however, places the matter in so clear a light, and raises its importance in the eyes of scientific men so considerably, that the subject cannot long remain one of indifference to the people at large. He shows, by very simple diagrams, formed from the records kept at Greenwich—which are reliable, I presume, and have been kept for a period extending over 50 years—that a “considerable decrease” in the amount of rain has taken place within that period. The Professor, when comparing the rainfall within the period from 1814 to 1864 inclusive, states that during the first 25 years the mean annual fall was 26·69 inches, or 1·44 inch above the general mean of the 50 years, and that during the last 25 years the mean fall was 23·75 inches, or three inches less than the first 25 years. He also shows that, during succeeding periods of seven and fourteen years, from 1815 to 1863 inclusive, the decline in quantity has been as follows:—

Years.	Inches.	Mean of 14 years.
1815-1821.. Mean rainfall	28·7	.. 28·3
1822-1828.. „	27·9	.. 26·1
1829-1835.. „	24·3	.. 24·7
1836-1842.. „	25·1	.. 24·6
1843-1849.. „	24·1	.. 24·0
1850-1856.. „	23·8	.. 23·8
1857-1863.. „	23·7	.. 23·8

If we deduce from this instance that the rainfall is generally declining, we cannot reject from consideration the counterbalancing circumstance that land drainage, which is taking place all over the country, discharges into the rivers from the land a *larger* quantity of water than found its way to them before drainage, and more than is actually lost to the rivers by the lessened rainfall. In fact, if the whole area of the Thames watershed consisted of wet land, which would be benefited by drainage, we should, in the aggregate, be considerable gainers by the extension of the practice; but the wet lands form only the smaller portion of its area, and therefore we can only apply the advantage to that lesser extent. Moreover, it is hardly necessary to repeat, the water of drainage issuing from our clay lands is not constant; it is for the most part discharged in the winter months, when both soil and air are frequently in a state of saturation and when vegetation is dormant, and ceases to flow in summer when evaporation is active and the demands of vegetation can hardly be satisfied. Hence it is that the underground operation of drainage, which we adopt for the amelioration of our heavy wet lands, adds to the derangement already caused by the improved cultivation of the surface and the spread of population. It extracts from the soil, in fact, the water which has hitherto been retained to moisten the air of summer and to support our rivers. Thus the floods of winter and the droughts of summer are both increased, and the hygrometric condition of the atmosphere altered so much as to make us acknowledge that England is undergoing an appreciable change of climate.

Before passing from this point, it is right to state that if drainage consisted only of subsoil drainage the tendency would be to render floods less frequent, because the water, having to pass through the soil intermediate between the surface and the drains, would be seized and detained in that depth of earth on its way to

the outfall, and if the rains were not repeated too quickly the sudden congregation of waters would be prevented. But as the primary object of drainage is to get rid of excessive wetness as soon as possible, the outlets and watercourses are now so much improved, and are every day becoming more and more improved, by straightening and widening, that the expected detention is more than counteracted by the facility afforded for the immediate discharge of both surface and drainage waters, which are precipitated into the valleys with a suddenness unknown fifty years back. The importance of this consideration can hardly be excluded from the immediate subject before us—the supply of water to the metropolis—for when this excess of water from drained lands, discharged as it is in winter, is added to the increased flow of springs and watercourses natural to that season of the year, it must be obvious that the surplus so placed at our disposal at one season to compensate for scarcity at another is a gift we ought not to reject. It is no part of the present purpose to specify with accuracy the quantity of water so placed at our command, though it is much to be regretted that the special terms of the Water Supply Commission prevented the Duke of Richmond and his colleagues from carefully inquiring into the capabilities of storage existing, and the means of making reservoirs, within the Thames basin. It is, nevertheless, of the first importance that these points should be understood by the country, for in the inexhaustible powers of storage exists the solution of the whole question of supplying London with economy. No one who has critically investigated it doubts the abundance of water existing in the basin of the Thames, though the prevalent opinion with the general public is the reverse.

While asserting that if storage be resorted to the excess of the driest winter will more than compensate for the drought of the driest summer by which it may be succeeded,* I am content to place before you the following facts in support of the assertion:—

Out of the average mean rainfall of 26 inches due to the Thames basin, it requires only $\frac{2}{3}$ of an inch of the surplus of winter from the whole watershed of the Thames, or $1\frac{1}{2}$ inches of rainfall from one moiety of the watershed, to satisfy the whole population within it. Or, to put the matter more practically, as it will only be necessary to collect water for six months of the year, half an inch of rain falling upon an acre of land is sufficient to supply two persons with 30 gallons each per diem for six months, and no winter passes by in which there does not run off to the sea, without serving any useful purpose, in excess of the mean summer flow of the river, at least five times the quantity required to meet the supply of the metropolis in the dry times of summer, when the river cannot fairly part with any portion of its volume; and this, or any portion of it, may be stored for compensation to the river if reservoirs were properly constructed for the purpose. To appreciate our present position it should be understood that the water companies are continuing the unexampled practice of abstracting from the Thames 60,000,000 of gallons daily, which may be increased to 100,000,000, independent of what is now desired to be taken by the East London Water Company, without any compensation whatever, although it is acknowledged that the volume of the river (which should always be maintained, if possible, at a standard flow,—say of 450 millions of gallons per diem) is sometimes reduced, in dry summers, after the companies have abstracted their supplies, to from 300 to 350 millions of gallons.

Now I pause to ask why this one-sided practice

* When speaking of the rainfall in years of scarcity we have been led into confusion by the published returns being tabulated according to the calendar year, whereas the summer flow of rivers depends on the preceding winter's rainfall. No month's rain has so much influence on the supply of summer as the fall of the previous October. If we have a wet October and an average wet winter the springs will be replenished, and the flow of our rivers increased.

* *Journal of the Royal Agricultural Society of England*, Nos. III. and V., second series.

should be continued. Is it right, with a declining rainfall and a declining summer flow, we should allow one-fifth, which may be increased to one-third, to be abstracted in summer without compensation, when, by simply storing the surplus of winter, we may secure the means of returning to the river any quantity equal to that abstracted from it, when the river volume falls below a certain recognised standard height? Unfortunately, the Legislature, in its wisdom, by granting, in the first place, to the five water companies drawing their supplies from the Thames, the power of abstracting 100 millions of gallons daily, and in the next by being a party to the payment of £6,400 a-year by those companies to the conservators* for considerations it is difficult to understand, has sanctioned and condoned this unexampled proceeding; and although the public interests have been prejudiced thereby, it is now too late to cancel these powers altogether. But it does not follow that a rule should not be made which shall be binding on the companies in future, obliging them to provide compensation for whatever water is taken from both the Thames and the Lea, when their volumes have fallen below a given standard at the points of abstraction, be the reduction what it may.

If this proposal were adopted we should hear no more of a scarcity of water, and the superior character of the river Thames and its tributaries would be restored.

I began by stating that among the influences conspiring to disturb the water economy of the country the sewerage of towns by the pollution of our streams was having a considerable weight, and as the prevention of this evil will test to the utmost the powers of conservancy, it may be well to make some general remarks, which may have their bearing upon the Thames and the Lea too.

The water-closet system has now acquired such a firm place in our household arrangements, that we cannot anticipate the use of any other vehicle but water for the discharge of sewage from towns of any size, however we may modify the system in villages, and for suburban and country houses, by the adaptation of earth closets, which are most excellent expedients, and will no doubt come into extensive use where combination in sewerage is not necessary to effect the duties of the scavenger. It is the daily increasing use of water-closets in towns, and the immense growth of special trades and manufactures using and abusing our streams, that sets aside all previous provision.

It is admitted that rivers, to answer their full natural purpose, must serve as drains to receive the liquid refuse of their watersheds, as well as sources of water supply for the towns within them; and, perhaps, the most difficult problem to solve in the present day is, the obligation to maintain, at one and the same time, these two objects—reconciling, as it were, the antipodes of riparian service. The conclusion, I believe, to which the intelligence of the country has arrived is, that, abstractedly no water can be used with impunity for drinking purposes after sewage has been mixed with it. Or, to give the matter a practical bearing, it may be more truly said that, as soon as sewage can be detected by chemical analysis to exist in an appreciable degree in the water we are called upon to drink it is a vital error so to use it. Of course, as rivers can but maintain their natural position as the drains of their watersheds, it is not possible altogether to exclude objectionable liquid refuse; and as some of the best chemical authorities

declare that the water of rivers, and the Thames among the number, if mixed with only a small proportion of clarified sewage, remains substantially innocuous, if advantaged by the oxidizing influence of a run of several miles before use, it is only necessary to determine with precision what proportion of organic matter, animal and vegetable, shall be allowed to exist in drinking-waters when delivered to the consumer. If we arrive at this we practically fix the chemical standard of quality, and it then remains to determine by what means it shall be maintained. Even in their aboriginal state all rivers received organic matter in the shape of decayed vegetation, and if we ascend to the higher portions of rivers for our water-supply we cannot exclude a certain amount of both animal and vegetable refuse, although the towns are comparatively small and few which are situated at the heads of rivers, and there are generally geological conditions of soil which favour the absorption of liquid matter. It is not for me to suggest what should be the standard of quality, but seeing that different companies taking water from the same spot,* deliver to their consumers water with very different proportions of organic matter, it is manifest that some rule should be fixed and accepted, and from which the water companies should not depart.

Professor Frankland stated, in his evidence before the Thames Navigation Committee of last year, that the quantity of organic matter in the Thames varied from three quarters of a grain minimum to two grains per gallon maximum, and with such data it would not be difficult to fix a standard of purity.

Of all methods of purification the application of sewage to land is the only one to which science accredits the power of arresting objectionable matter, though the mode of application is found to govern the extent to which the process succeeds. Sewage discharged from towns by gravitation, or lifted by mechanical power to high grounds, if it passes simply over the surface of land without passing through it, retains a large part of the noxious matter, and cannot be considered to be in a fit condition to mix with river water used for drinking. This view applies with increased force the nearer the irrigated lands approach the river. The absorbent powers of vegetation are doubtless very great, but they are not sufficient in themselves to appropriate the impurities held by water in suspension as well as in solution. Moreover, vegetation has not equal vital powers all the year round to seize and appropriate the fertilizing elements which are its food. It has its seasons of rest as well as of growth, and at such times its extractive and retentive capabilities are very small. When vegetation, however, grows on a deep bed of free soil, through which the sewage can descend and percolate, after satisfying the vegetation, we possess the best means of purification, its perfection depending quite as much on a sufficient depth of subsoil through which the effluent water must descend as upon the action of vegetation.

We must not confuse the system of irrigation which allows of the effluent water to sink into the subsoil *after satisfying vegetation* with the “dumb-well” or cess-pit mode of disposing of sewage in its normal state. In the first case, the effluent water which would pass into the river as clarified sewage, if “run over land” sinks into the soil and replenishes the springs, after being utilised on the surface; whereas, in the second case, the sewage is dropt into holes of porous ground, which retain the solid matter to fester under foot, and allow the liquid sewage to sink into the earth without doing any good whatever to vegetation.

Where free soils affording natural drainage are not to be obtained, the nearest approach to them is land to which underdrainage has been or may be applied, the drains in such case affording artificially a means of discharge, when the level of the drains is reached, similar in character to that which takes place in a deep

* The following are the payments made by the water companies taking their supplies from the Thames to the conservators:—

	By agreement, 1852.	By Act, 1866.	
Chelsea	300	+	1,000 = 1,300
Grand Junction	300	+	1,000 = 1,300
Lambeth	200	+	1,000 = 1,200
Southwark and }	300	+	1,000 = 1,300
Vauxhall			
West Middlesex	300	+	1,000 = 1,300
	1,400		6,400

* See Appendix XIV. to the First Report of the Rivers Commission.

bed of free soil when the descending water reaches the level of the springs. But as the depth of under drainage is limited to a few feet, the extent of purification is limited correspondingly, and though to the eye, and probably to the taste in many instances, the discharged water from lands irrigated with sewage may be unobjectionable, I believe I am correctly stating the fact in saying that such water is seldom if ever free from organic matter. The question which therefore arises, when applying sewage to drained land, is whether the filtration it undergoes, in addition to absorption by vegetation, is sufficient to allow of the effluent liquid from the drains being mixed with impunity with river water used for drinking. Abstractedly, it is wrong to do so; but, as under many circumstances theory cannot always be carried to its extreme, it will probably often occur that the distance to be travelled by the mixed waters before use will be sufficiently great to effect oxidization and so remove all objection. Expediency may thus over-ride principle and sanction the proceeding.

As a rule, it may be assumed that the application of sewage will be profitable in proportion to the command the farmer may have over the sewage he applies. It may percolate the soil and pass away too quickly, and a sufficient breadth of land may not be covered at a dressing. The irrigated land may, in fact, be far too open and free for the farmer's profit, though not for purification. To irrigate undrained clay lands is opposed both to profit and purification, for it cannot be expected that land already suffering from excess of the rainfall will benefit by double the quantity of sewage-liquid being run over it and added to the rainfall. The same lands drained will bear any amount of irrigation with an increase of produce of good quality, though the effluent water may remain polluted; but to apply sewage to land possessing no escape through the soil is to "put the compost on to make the weeds grow ranker," for the herbage can only be coarse and very inferior in character. When we have had more experience in sewage farming—and it will doubtless become a special business, as the Rivers Commissioners have pointed out in their reports—it will probably be found that a system of drainage admitting of the plugging of the outlets, so as to hold back the water in the soil for a time, and to flush the drains, will be adopted. In some parts of England this plan is adopted for water irrigation with success.

Thus we are compelled to view the application of sewage to land in three ways:—

First. That sewage run over a surface of land which has neither natural nor artificial drainage to assist vegetation in retaining the deleterious elements, altogether fails to secure that degree of purity which will allow of its being discharged into rivers, from whence may be taken water for drinking purposes, though the operation may serve to clarify and improve its character sufficiently to allow of its being utilised in rivers for navigation, and for many other riparian uses.

Second. That land artificially drained to a depth of a few feet affords, if irrigated, only an imperfect means, in conjunction with vegetation, of separating from sewage its objectionable elements.

Third. That where sewage can be lifted to high and fertile grounds with a free and porous subsoil, which will admit of its penetration to a considerable depth after it has fed vegetation on the surface, a perfect means of purification may be attained.

With these conclusions as to the utilisation of sewage and the steps to be taken to exclude it from rivers when in an objectionable condition, we have to consider how far they will be acted upon or enforced by the Board of Conservators, under whose care the Thames and its tributaries are now placed; and in my remaining observations I shall content myself by bringing before you the position and duties of the Conservators of the Thames in relation to water supply, and the powers they possess of securing to the five water companies, with whom Parlia-

ment has associated them, water of unobjectionable quality.

In speaking of quality, I am aware that I shall bring to the minds of many the question of *hardness*, which is one of great importance. It forms no feature of my paper on the present occasion, because, as its title implies, it is confined to the Thames and its tributaries, and it is not possible to obtain from these sources any other character of water than that partaking of from 13 to 18 degrees of hardness. If we were comparing the water of the Thames with other and distant sources of supply, offering different qualities of water or different degrees of hardness, the object would be directly pertinent, but I desire to exclude all points which might provoke a discussion on the relative merits of the different schemes now proposed for the supply of water to London, and which would have the effect of diverting attention from the Thames. My own name, indeed, has been associated with a proposal for utilising the upper tributaries of the Thames in conjunction with the storage of surplus waters, in which I still retain the utmost confidence, but I do not appear here to night as an advocate of that project, feeling that I should be abusing my connection with the Council of this Society were I to do so. It cannot be denied that to exclude the question of hardness from any discussion on the supply of water to a great community like that of the metropolis is to omit a very important element, but when you are reminded that its introduction would open up a wide field of argument as to the national policy of abstracting water from one valley to supply it to another, the power of reducing hardness by chemical appliances, and the relative healthiness of hard and soft water—the consideration of which alone would be sufficient to occupy the evening—you will probably concur with me in a desire to confine our attention to the present powers afforded by Parliament for securing to the metropolis a supply of wholesome water from the Thames through the agency of the water companies, with the support of conservancy.

The urgency of the question of metropolitan supply is demonstrated by the fact that while we justly hesitate to take water from the high grounds surrounding the manufacturing districts of the north-west, because the increase of population in those districts is truly prodigious, and in excess of the increase of the metropolis itself, the addition each year to the population of the metropolis is 40,000, which, I need not tell you, alone exceeds the number of people in the majority of county towns in England.

To describe in detail the constitution and duties of the Board of Conservancy of the River Thames would take too much of our time, but it may be useful to state that the Corporation of the City of London, who were the original conservators, transferred their powers and duties to the Board constituted by the Act of 1857, and with them the obligations of an agreement entered into in 1852 with the five water companies drawing their supplies from the Thames, by which £1,400 a year was arranged to be paid by these companies to the conservators "as compensation for expenses incurred by the conservancy in consequence of the works of the companies." In 1864 the constitution of the Board was reorganised, though its duties and jurisdiction were still confined to the improvement and control of the river below Staines. Those duties professedly were the maintenance of the navigation, with jurisdiction over the shores and the uses of the river, and the actual works of the Board extended only to the preservation of the banks, locks, weirs, and other river works essential to navigation, and to the dredging and scavenging of the river itself. Last year the jurisdiction of the Conservancy Board was extended from Staines as far as Cricklade, and the Legislature, considering it expedient that a provision should be made for preventing the pollution of the river, and that the five water companies drawing water from it would be benefited thereby, authorised and imposed the payment of £1,000 a year

from each company to the Conservancy Board, having rendered it obligatory on the part of that Board to scavenge the surface of the river, in order to the removal therefrom of all substances liable to putrefaction, and to clear the river of weeds, that they might not decay. It would appear, however, that there was some doubt in the minds of the committee which settled the Act whether the presiding authority of the river might not itself be sometimes at fault, for by the fifty-first clause of the Act provision is made for an appeal to the Board of Trade, "should any work executed by the Conservators, in the opinion of the five metropolitan companies, injuriously affect either the flow or purity of the water of the Thames." No works to be executed by the conservators seem to be contemplated by the Act of last year, nor indeed by the Bill of this session, either for the increase or purification of the water of the Thames other than those essential to a proper maintenance of the river for navigation. The actual operations of the Board would appear to be limited to improving and maintaining the navigation and the supply to mills, and in scavenging the river, while its powers are extended to preventing towns and persons from polluting its waters by the discharge of sewage and obnoxious matter. The Act of last year declares that it shall not be lawful for any sewage to discharge into the river, or into any stream connected with it, within three miles of the main trunk (which provision it is presumed will shortly be extended to all the tributaries), and it requires the Conservators to give notice to any person or body to discontinue the discharge of sewage after a certain time named in the notice, which shall not be less than twelve months nor more than three years, imposing a fixed penalty, payable, by any one disregarding the notice, of £100, with a further penalty of £50 a day if the nuisance be continued. With the service of the notice and the legal proceedings against any one disregarding them, the direct action of the Conservators—as respects the purification of the river—ends. They appear to be a valuable medium for enforcing the law.

Though they have the authority to prevent the continued abuse of the river by pollution, they cannot prevent a legitimate use of its waters as population and trades increase, and agriculture may require it; and though they would successfully resist the water companies taking out of the river more than they have parliamentary powers to take, the Conservators have no power to enforce compensation from storage, let the effect be what it may. With powers of so little practical advantage as respects water supply, it is difficult to understand for what purpose the water companies are paying the additional £5,000 a-year, which, by the Act of 1866, they are collectively bound to pay. The first contribution of £1,400 a-year may be taken as payments incident to, though not directly for, the abstractions at Hampton, which in some degree affected the navigation below; but with respect to the last payment of £5,000 a-year, there exists no similar reason, inasmuch as the companies have no additional powers given to them, either to take more water, or to abstract it higher up, where it would affect the navigation above Staines. The payment could be understood if, by any actual expenditure on the part of the Conservancy Board, the additional quantities of water the several companies have yet the power to take were positively secured to them, without raising any objection on the part of the public interested in the river. If, on the contrary, the £5,000 a-year is, as I have supposed, required to maintain the river banks and works for the upper navigation, it would only appear right that those interested in, and to benefit by, that navigation should find the money, particularly as the Act recites that "if the duties of the conservancy of the upper part of the Thames were efficiently performed, the traffic on the navigation, and the income derivable therefrom, would considerably increase." With this expectation, there

could have been no difficulty in raising any required amount of money by a loan, repayable by instalments, extending over a sufficient length of time to realise the assumption. As it is, however, the interests of the public have been sacrificed, and, as I have before stated, a prejudicial compromise effected. The water companies doubtless consider that they are paying their £1,000 each for the privilege of drawing their water from the Thames as it passes by Hampton in whatever condition it may be secured to them by the proceedings of the conservators of the river, and that they are exonerated by the payments they make from compensating the river for any quantity they may in future take out of it, within the limits of 20 millions of gallons each, even though the flow of the Thames may from other causes be materially reduced. No doubt the companies are justified in so regarding the arrangement, but it remains with the public to say whether some modification must not take place.

The quantity of water yet to be taken from the Thames under existing Acts is 40 millions of gallons daily, and this is likely to be increased by the 10 millions required by the East London Water Company. This company, with the New River Company, have absorbed the entire dry weather volume of the Lea, after the navigation has taken its prescribed quantity, and the company is obliged to come to the Thames for its immediate wants, no effort having been made in the valley of the Lea to store its surplus waters.

So great is the increase of demand for water in the metropolis, that it may be but a very few years before the maximum quantity which the companies are empowered to take may be reached. In the meantime winters may succeed, like the last, in which the valleys of the Thames and its tributaries may be in a state of inundation, involving local losses of an immense aggregate amount; and it may be fairly asked whether a compact such as the Legislature has sanctioned shall continue to have effect without an effort being made so to balance excesses that the evil of one season may be turned to the benefit of the other.

It is only in this way that we may satisfy the question of quantity, and, having placed before you in earnest terms, the difficulties resulting from the Parliamentary compact I have referred to, I leave it in your hands for consideration.

I will now recall your attention to the question of quality. It may be found that the towns called upon by the conservators to discontinue the discharge of their sewage into the river may evade purification by the adoption of imperfect works. Some may have recourse to irrigation on river-side meadows without drainage, whereby, as I have already stated, the effluent water may flow into the river clear to the eye, though almost as foul as before. Others will adopt different expedients, but all will abstain as long as they can from incurring the extra expense of lifting the sewage on to high grounds, or even of under-draining the irrigated lands (which, as I have said, should always be insisted upon where natural drainage does not exist), to secure the necessary absorption which is essential to that degree of purification required by water-drinkers.*

In the meantime, the contributions of the water companies will be paid to the Board of Conservancy, and

* We may see on the Lea a very telling instance of the way in which money may be spent in proceedings carried out in obedience to an Act of Parliament, without producing the intended effect. It is described in the words of the Rivers Commissioners: "By an Act passed in 1854, the New River Company obtained powers to lay down intercepting sewers through Hertford, to convey the effluent water past the New River head into the Lea." These works cost £2,200, and £700 is paid annually to carry out the process. "The effluent water passes away clear," and being mixed with the water of the Lea, is drunk by the water consumers of the metropolis, though the people of Ware, the town immediately below Hertford, find this "clear sewage" "a constant cause of complaint." It is declared by the Rivers' Commission to be sewage still, with the disadvantage of appearing to be different to what it really is.

this implies an obligation strengthened by each succeeding payment.

It has never, I believe, been publicly suggested, though the proposal is worth consideration, that, as the authorities of the towns now discharging their sewage into the Thames may fairly content themselves with, and satisfy their ratepayers by adopting, the cheapest disposal of the sewage which shall legally meet the terms of the notice which may be served upon them, it may be only right that those who are requiring such a purification of the water as shall make it fit to drink should pay something towards the difference between the cost of carrying out irrigating operations which shall legally satisfy the conservators' notice and those which will satisfy the water-drinkers of the metropolis.

Compared with the application of sewage to lower grounds by gravitation, the lifting of sewage on to high grounds not only involves a greater first cost, in modifying and extending the outfall works and in erecting steam engines, pumping-stations, and appliances, but there remains as a constant outlay the cost of fuel, wages of engineer, &c., which form no items when irrigating by gravitation. Does it not appear reasonable that some proportion of this outlay should be paid by those who require a degree of purity beyond simply clarifying the sewage so that it shall satisfy navigation and other riparian uses.

To put the matter in a tangible form, and having in view the towns of Banbury, Oxford, Reading, Abingdon, Wallingford, Windsor, and the many other towns on the Thames and tributaries above Hampton, I may state that the annual cost of raising the sewage of 250,000 persons to a height of 100 feet, and to a distance of five miles, may be fairly taken at £5,000 a year.

Now, as the £5,000 a year, payable to the conservators under the Thames Navigation Act, 1866, consists of the money of the water drinkers, though it passes through the hands of the water companies, is it not fair that the whole or a part of the annual outlay required for lifting the sewage of such towns as are situated above the point of abstracting the supply to the metropolis, should be paid out of this fund? This amount (£5,000), if so applied, would go a very great way towards satisfying the question of quality—assuming that the towns referred to would meet the question by taking upon themselves the extra first cost of the necessary works.

This suggestion appears equitable and right in many respects, and I leave it for your consideration, merely adding that by apportioning the £5,000 a year among the towns according to population, the conservators would be relieved of the anomalous position of receiving money from the water drinkers of the metropolis, without making any positive effort to raise the quality of the water to a standard of purity.

In bringing these remarks to a close, it will not be necessary for me to assure you that I am conscious of their imperfect nature. With a subject so large, I have experienced more difficulty in bringing what I have had to say into a small compass, than in finding matter to support the few objects I have desired to make prominent. I have nevertheless managed to curtail my observations to limits which have left good time for discussion—which is the more desirable as this meeting is the last of the session.

DISCUSSION.

Mr. S. C. HOMERSHAM said, if he understood the paper aright—and he had taken some pains to do so—the question raised in it was, whether a large body of flood water should be impounded in the upper tributaries of the Thames, or in the Thames itself, and let out in dry seasons for the purpose of giving a more equable flow to the river. The writer of the paper had not said very expressly that this was his view, and he had not given, for instance, the quantity of water which ran down the river in flood times, and the quantity that

flowed down in dry seasons, nor the area of the watershed of the Thames, nor, in fact, any exact data to go upon by which it could be ascertained whether such a proposition could be dealt with or not. All data of this kind—whether studiously avoided or not he could not say—certainly were kept out of the paper, and there was no proposition before the meeting except a general one that flood waters should be impounded in ordinary reservoirs and given out in seasons of drought. If they were to discuss that question intelligibly they must have data and figures of an exact and positive character, whereas the only figures of any kind given were (and he believed that they were correct), that there was an average rainfall of twenty-six inches in the watershed of the Thames, this being assumed from the ascertained average of the rain-fall being twenty-four inches at Greenwich. The area of the watershed of the Thames down to the point where the water companies took their supply was 3,500 square miles or thereabouts; and the area of the watershed below Hampton to the mouth of the river was about 1,500 square miles, making altogether 5,000 square miles as the watershed of the whole river. But before discussing the proposition which was made, it was necessary to know what was the character of that watershed. There were some large districts of country upon which, from the physical configuration, and from the character of the soil and the rock of which they were composed, water no sooner fell than it ran off; and within a few hours after a heavy rain all the water, or nearly all, flowed off through the brooks and streams, and came down in a heavy flood. He knew districts where very large impounding reservoirs might be dry at 9 o'clock in the morning, and if there were heavy rain would be quite full and running water to waste at three o'clock the same afternoon. That was the character of many soils, but there were others where there might be heavy rain, even to the extent of $1\frac{1}{2}$ inches or more in the hour, but where no water at all would appear in the streams, the whole being absorbed by the drainage-ground instantly, and sinking beneath the surface, and where one might go over the ground when the rain was over and almost say that it would not be wet, and there would be no flood or water at all even in the valleys and on the lowest ground. He knew a district in one patch, of 272 square miles, where neither river, spring, nor stream was to be seen on the surface at all, the whole of the water which fell upon it being immediately absorbed into the soil and rock of which the district was composed. Now, the having to deal with a soil of that character, or with one where the water ran off immediately, were two very different things, and therefore they must examine not only the area but the character of the drainage-ground of the Thames. Of the 3,500 square miles which he had given as the area of the drainage-ground down to Hampton, about 1,200, or a third-part, consisted of chalk, a character of soil so porous that no sooner did rain touch it than it was absorbed; there was also another portion of the drainage-ground where the sub-soil was greensand, which was also another absorbent rock. Below Hampton Court he found 600 square miles of the drainage ground to be chalk, so that in round numbers it was correct to say that one-third of the total drainage ground consisted of a soil that absorbed water as soon as it touched it. Dealing first with the portion above Hampton, the first place where the chalk appeared in the river course was at Maidenhead, and then the river ran on for about 30 miles, following the sinuosities of the river, on chalk, after which the chalk disappeared. The level of the water standing in the saturated chalk at Maidenhead was 60 or 70 feet above Trinity high-water mark, and the level of the chalk saturated with water in the Chiltern range, beginning near and above Luton and Tring, was 450 feet above Trinity high-water mark. The variation in the line of the saturated water level in the highest point was something like 40 to 50 feet in the year, being highest, generally, about the end of June, and lowest at the end of December. There was a saying in

those districts "as the days lengthen the springs strengthen," which was really true, as up to about the longest day the water gradually rose, and from that day to the shortest day, as a general rule, it fell, the variation on an average, and taking one season with another, being about 40 or 50 feet. Now, a cubic foot of dry chalk would absorb $2\frac{1}{2}$ gallons of water on an average; all chalk was not exactly of a like quality, but about one-third of the bulk of chalk consisted of small pores, and, as a cubic foot would be equal to $6\frac{1}{2}$ gallons, it would take up on an average considerably more than two gallons of water, so that fully a third of the cubic contents of saturated chalk was water. This was very important in considering the question before them, because, seeing that there were 1,200 square miles above Hampton, where the whole rainwater falling upon the ground was absorbed, and that there stood at the Chiltern ridge chalk saturated with water to the level of 450 feet above high-water mark, and to 70 feet at Maidenhead, it followed there was an average depth of 260 feet of chalk above high-water mark saturated with water, which was equal to a column of water itself 86 feet in height, so that literally there were 1,200 square miles of chalk in the drainage ground of the Thames, above Hampton only, with free water in it to the depth of 86 feet. This was a matter of fact—there was no question of theory about it. The tops of the hills of the Chiltern ridge varied from a thousand to six or seven hundred feet high, and taking the average at five or six hundred feet the dry ground would average 200 feet down to the saturated chalk, and below that there were 360 feet of saturated chalk, equal to 86 feet of free water. A very simple calculation would show that this was equal to about 18 trillions of gallons of water, or to a supply of 200 millions of gallons of water per day for 246 years. This could be clearly demonstrated. No doubt few persons present were sufficiently acquainted with the facts to know that when standing on those chalk hills, so dry on the surface and covered with very scanty herbage, they were really standing above quite a sea of water. That was the state of the case with regard to the large portion of the drainage ground of the Thames before described. There was water already stored in the chalk equal to a supply of 200 million gallons per day for 246 years, even if it were never replenished. Now, taking the rainfall at 26 inches, it would be but a small amount and an under-statement to say that 10 inches went to the lower depths. From an experience of 25 years in sinking wells and so on in the chalk, he (Mr. Homersham) believed it was much nearer 20 inches, but he was content to take it at 10 inches, which would give these 1,200 square miles as being replenished with a quantity equal to 408 millions of gallons of water per day for every day in the year. Now, with such an enormous natural storage reservoir so amply filled and so amply supplied, and so constantly replenished with water from the clouds, why should they try to impound in artificial reservoirs the flood waters for dry seasons? In his opinion it would be a very unwise proceeding, because every one who had had anything practically to do with water impounded in large reservoirs should know that it was not of a wholesome quality for the supply of large towns. For instance, the water in Loch Katrine was, no doubt, very free from mineral matter, but it contained a considerable quantity of organic matter, and decomposing organic matter, especially in warm autumn seasons, that was unwholesome, while before it got to Glasgow from Loch Katrine a portion of the oxygen combined with a portion of the organic matter, and the water became partially de-oxygenized. However, leaving that subject, he (Mr. Homersham) considered that to store water in open reservoirs and then lower it down the Thames, would be very unwise, because water standing in these artificial reservoirs became of necessity mixed with fallen leaves, faded blossoms, the droppings of animals, and other impurities, and became of worse

quality even than the flowing water so contaminated. These artificial impounding reservoirs were usually made in the most barbarous manner. They often had a depth of several feet of mud and filth at the bottom, and there were no means provided for cleaning the reservoirs out, and the water became full of confervæ and living organisms, in fact such as no water company ought to supply for domestic use. The proper way of supplying the water to the companies from the Thames would be to get at this water naturally stored in the pores of the chalk and to use it for the supply of London, which would prevent any interference with the navigation. This was being done in spite of every obstacle so unnaturally put in the way for many years past by government. They had all read in the papers of the poisonous character of the water that had been given by the companies at different times to London, and the number of the persons who died really poisoned by the water; that was due, he had no hesitation in saying, to the improper interference of the Government, or those acting under their authority, who made up blue books, and had prevented new companies from supplying pure water to London. Passing on to the lower part of the Thames below Hampton, there were 600 square miles of chalk to be found forming a portion of it, and one water company (the Kent Company) had already abandoned the river and gone to that source for supply, and now supplied water from that source to 32,000 houses, or a quarter-million persons, and for some time had not taken a drop of water from the river, but had gone to the chalk and obtained the water direct from wells. The New River Company also were gradually resorting to springs, or to wells sunk in the chalk. Such water at its source was of the best possible description for the purposes of a water company, being perfectly free from all organic matter, living or dead, and of one even temperature summer and winter. In the summer it was comparatively cool, 52° Fahr., while Thames and other surface water was 68° or 70°, and in winter it was about the same, when Thames water would be 33° or 34°, so that it was not liable to freeze in the pipes. The only thing which could be said against the water was that it was hard; but by a simple process, which had been in successful operation for many years, it could be reduced from $2\frac{1}{2}$ degrees to $3\frac{1}{2}$ degrees of hardness. Therefore, in the interests of the health of water-consumers, he hoped there would be no attempt to impound water in reservoirs on the Thames, but that the river waters should be altogether abandoned, and resort should be had at once to the natural reservoirs in the chalk for the supply.

The Rev. J. CLUTTERBUCK thought it was quite useless to make any calculations in reference to water supply founded on the average rainfalls, as the minimum only ought to be taken; and he also objected to the average which had been taken by Mr. Bailey Denton, as deduced from the observations at Greenwich. He most emphatically denied that the rainfall had decreased during the last fifty years; observations of his own for sixteen years, and of others on whom he could rely for twenty-nine years, showed rather an increase than the reverse. This seemed a principal point in the paper, and he therefore wished to remove what seemed a false assumption, which might unnecessarily frighten people. Nor did he think that anything which could be done in the way of cultivation of land, draining, or cutting down timber, would in the least appreciable degree affect the rainfall, which was due to the Atlantic and Northern oceans. The storage of water in the Upper Thames might be very easily accomplished, as there was great power of storage in the river itself. He concurred with a good deal which had been said by Mr. Homersham with reference to the springs in the chalk, and believed it might be proved that the greater portion of the water which passed over Teddington lock at some seasons was derived from that source. If any one could see the miserable ruined inheritance on which the Thames Con-

servancy had entered, they would know that a great deal more money must be spent before the river could be restored to its proper condition, and one very great point gained would be the saving of the water by improvement in the navigation. With a little patience he believed they would see that they need not go elsewhere for water, but that Old Father Thames would be true to his great mission, and give them a good and abundant supply.

Mr. R. RAWLINSON, C.B., said he had listened with considerable pleasure and interest to the remarks of the preceding speaker. The amount of rainfall was dependent upon causes of so vast a character, that he was perfectly satisfied that anything man could do would only modify it to an infinitesimal extent. Cultivation, clearing of land, and draining, would have but a very fractional influence on the fall of rain. Averages for even fifty years were not to be relied upon, but whether the rainfall had decreased or not they might take it for granted that nothing they could do would influence it either for good or evil. They could, however, economise that which fell on the surface; and he might mention one fact to Mr. Homersham which he might add to the facts which he had stored up with regard to the great gathering grounds of chalk, which he supposed to be of such vast absorbent powers. It had been his (Mr. Rawlinson's) duty to obtain accurate observations, extending over a considerable period of time; they had been obtained by men on whom he could thoroughly rely, and the results were very surprising. Mr. Muir, of the New River Company, Mr. Greaves, of the East London Company, Mr. Beardmore, a gentleman of world-wide reputation in such matters, and Mr. Jas. Simpson, were his informants. The Thames had been gauged accurately for a series of years over Teddington Weir by Mr. Simpson, and the daily volume of water which flowed down ascertained, with the exception of excessive floods, and those were known approximately. The other gentlemen had carried out a series of observations on the River Lea with reference to the water supply and also for settling the legal rights of the several proprietors. The result was that, out of an average of 25 inches of rain, taking that as the datum, four-fifths of the entire volume could not be accounted for by measurement in any way, and they could only come to the conclusion that 20 inches out of the 25 passed again into the atmosphere. That result was so startling that he himself was sceptical at first until he had thoroughly investigated it. Now, as far as his investigations went, the minimum rain-fall in the valley of the Thames, and also pretty generally over England, and indeed all over the world, as compared with the maximum, was as one to two, and, as Mr. Clutterbuck had said, in any calculations it was necessary to take the minimum. Now, deducting one-third from the average would give the minimum, and adding one-third would give the maximum. So that, avoiding fractions, the minimum in the valley of the Thames would be about 16 inches, and the maximum about 32 or 33 inches. Down to 16 inches, therefore, they must bring their calculations, and he did not suppose Mr. Bailey Denton contemplated making reservoirs for more than 365 days' supply, about 120 to 200 days being generally considered sufficient by engineers. He regretted that a writer so well able, from his large experience, to handle this subject, should have used the word "compact" as describing the agreement made in the Act of Parliament between the Thames Conservators and the water companies. He did not think it was a proper word to use as applied to such a subject. He thought it rather implied that the public had been "sold" by that "compact."

The CHAIRMAN did not think the language implied that at all.

Mr. RAWLINSON said he entirely justified the demand made upon the water companies; he had had as much to do with it as anyone, and if his advice had been taken

the sum would have been doubled. Previously, the companies had Parliamentary powers to take the water without paying anything for it, and in the meantime the river was going to ruin in every possible way, weeds growing, channels choked up, shallows silted, all sorts of garbage allowed to be thrown in, and no scavenging whatever. The stipulation was that the Conservators should restore the river and cleanse it, so that in fact the companies had a cheap bargain of it, and the public were benefited by the transaction. With regard to the application of sewage, that also was a speciality of Mr. Denton's, but he thought a little further inquiry would teach him that sewage was clarified by a proper application to clay land, even if not underdrained, which Mr. Denton stipulated for. He (Mr. Rawlinson) by no means said the land should not be underdrained, but he could assure Mr. Denton that some persons, practically acquainted with sewage irrigation, would prefer, from their experience, to irrigate claylands without underdraining, if Italian rye grass, which was the most profitable crop, were to be sown. In this grass the roots were near the surface, and the silica of the clay combined with the sewage and tended to precipitate it. Experience showed that when such irrigation was judiciously carried on, although the process of assimilation did not proceed equally at all times, there was not a day in the year, winter or summer, when you could not beneficially place sewage on the land, and when that sewage would not come clarified from that land. That had been proved, and it was a very important fact. He sincerely hoped that Parliament would follow the advice given in the paper, and make sewage irrigation imperative on all towns which now tainted rivers with it, for it never would be done until the law was stringently applied. Parliament had yet to learn the immense importance of following up laws by strict supervision, so as to see that those laws which affected the whole community were effectively carried out.

Mr. HOMERSHAM said, with reference to the disappearance of four-fifths of the rainfall, that not only was he aware of that fact, but he knew a large district where it disappeared altogether.

Mr. RAWLINSON remarked that if the water disappeared from the surface, it must come out again somewhere. The only conclusion he could come to was that it was lost by evaporation.

Mr. HOMERSHAM said the water went to the sea through underground fissures, being carried off by springs below high-water mark.

Professor VOELCKER said he understood Mr. Denton to say that there were great difficulties in the way of sewage water that passed over land being perfectly purified. There was no doubt some truth in this statement, but if sewage farms were really properly managed the purification of sewage might be rendered perfect; inasmuch, however, as there were not these model establishments, and in many cases the water simply flowed over the land, the purification was generally very imperfect. It was far more difficult to get the water through the soil than was generally believed, especially on clay lands, where it often ran through the cracks, and did not actually go through the soil at all. Where properly managed, however, sewage water, after passing through the soil, became quite fit for ordinary uses and for drinking. There was one other purely chemical question on which he would make an observation—the organic matter in water. The writer of the paper thought it would be desirable to have a fixed standard for the amount of organic matter which should be present in water for drinking, and Mr. Homersham said that some water was perfectly free from these matters. Chemically that was not correct, as no natural water was absolutely free from organic matter, although to a non-chemical eye it might appear so. He thought it would be desirable to have something like a standard of purity, but without knowing the kind of water, it would be extremely dangerous to fix such a

standard. He had had water for analysis which contained very little organic matter, and yet which he had no hesitation in pronouncing totally unfit for drinking, whilst other samples, which contained three or four times as much organic matter, were useful and wholesome. It was not so much the amount as the quality of the organic matter which was of importance, and hence the difficulty of fixing the standard by quantity. In practice, a very good test of the presence of injurious matter was to bottle off a portion of the water for a fortnight or three weeks, and then examine it, when, if the organic matter, however small in quantity, were in a state of decomposition, there would be an unpleasant smell. This was perhaps as good as any chemical test which could be applied. There were great difficulties in estimating with precision the quantity of nitrogen, as suggested by Professor Frankland. If that could be done it would be a step in advance, but as that could not be done, there would be very great difficulty in fixing a standard for the amount of organic matter which might be tolerated in drinking-water.

Mr. BOTLY, in explanation of a discrepancy between the amount of rainfall as stated in the report of the Royal Agricultural Society and that given elsewhere, stated that the reports were issued a considerable time after date. He also remarked, in reference to the cultivation of Italian rye grass, that where it was attempted without sewage irrigation, the soil was very much exhausted, in some cases causing the total failure of the succeeding crop.

Mr. NEATE, M.P., wished to call attention to what had been said by Mr. Homersham, which had made a considerable impression on his mind, about the unwholesomeness of water which had been stored. He had been one of those who had attached great importance to the storage of water in the valley of the Thames, but it now appeared from what had been said that this would be of very little value, because the water would not be wholesome. He thought this would much depend, however, on the way in which the water so stored was kept up. Was it to be merely by the overflow of the water in the river, or by the turning into it of streams in the summer season? If it were kept up in that way what advantage would be gained by turning those streams into reservoirs which would not be gained by turning them into the river itself? Mr. Homersham seemed to value the great chalk reservoirs, not so much by what they gave out as by that which they kept in. They all knew, however, that there was an immense amount of water in these chalk reservoirs, but its only value was when it was released therefrom.

Mr. TOWLE gave his opinion in favour of reservoirs, and remarked that it would be no new thing, there having been in the neighbourhood of Standlake and other places above Oxford (until draining and other agricultural works had destroyed them), immense natural reservoirs, which served to feed the stream in summer seasons, and which he, as a miller, now felt the want of very much. He also thought that better regulations for ensuring a perfect flow and scouring of the river would be very beneficial.

Mr. BAILEY DENTON, in reply, said that he had carefully avoided referring to what was known as his own scheme, or the project with which his name was connected, which was the utilization of the upper streams of the Thames in connection with storage. That would explain the omission of many details, as Mr. Homersham and Mr. Rawlinson would understand. The same explanation would apply to Mr. Clutterbuck's remark that averages of rainfall had very little to do with the question. He had himself frequently stated (he believed in that room) that the minimum rainfall was the real basis to be taken. With regard to the exception which had been taken to the use of the word "compact," he thought he could hardly have chosen a word less liable to an offensive interpretation; but, if it was thought desirable, he would withdraw it, and substitute the term "agree-

ment" or any other term that might be preferred. Mr. Rawlinson's authority stood as high as that of any man in relation to the question of irrigation by sewage, but if he had understood him aright in saying that the drainage of such land was not necessary, he must, with the greatest respect, give a contradiction to such a statement. He considered it absolutely essential. With regard to the storage of water, he did not say that such reservoirs as Mr. Homersham had referred to would not be objectionable, but he had not at all gone into the question of what reservoirs would be desirable, if it were necessary to supply London direct from reservoirs. The whole of his observations on that and former occasions had tended towards conserving in winter the surplus water, in order to compensate the river in summer for what was taken out of it, the water not being supplied direct to the consumers from the reservoirs, but returned to the river. That perhaps would satisfy the gentleman (Mr. Neate) who wished him to refer to that point. At the same time, he must not be understood to hold that reservoirs could not be constructed in the valley of the Thames, in which water might be preserved for drinking purposes. He believed they knew very little about what might be done in that way, if there were proper means adopted for purifying the water, and that the conservation of water in large reservoirs of sufficient depth would tend to improve its quality, rather than to injure it.

The CHAIRMAN, in proposing a vote of thanks to Mr. Denton, said, that of course anybody with the experience of Mr. Homersham or Mr. Rawlinson could have added a great deal to the paper, and so could the writer himself had he not been restrained by the time at his disposal. It seemed to him that the paper had brought before them the prominent question on which the public must pronounce a decision before long. As to the question of the rainfall, he quite agreed with what Mr. Rawlinson had said, but that, after all, was a secondary consideration. The operations of nature were conducted on so vast a scale that anything man could do would not produce any perceptible effect, but still he should be very sorry if the local observations which had been conducted with such great care were discontinued, because they were of very great value. If, however, they were told that improved drainage increased the floods and the droughts, he said these questions were not worth a moment's consideration with reference to the great question of the supply of water to the river. They who knew what took place in the north and west of England, especially in mountain districts, knew very well that it was the great mass of water brought from the ocean to which they looked; and although the rain was largely absorbed before it came to this more southern locality, still it was practically to that source that we must look for a supply of water. Therefore, although it was very wise to make these observations, for all practical purposes they might be disregarded. He was reminded by this discussion of the answer which a celebrated engineer gave to the question of what use rivers were. He said their only use was to supply canals. So, in relation to this question, he should say that the use of valleys was to store water. He believed that there was an unbounded supply for the wants of man if they took the minimum water supply of any district, which, as had been said, might be taken at 16 inches; if all that were stored, it would be abundant for generations to come. He believed, from what he had heard in the course of professional experience—for he had no practical acquaintance with the subject—that water stored in large bulk was improved in quality. Where it was stored in small bulk and in shallow depths, it might become impure, but in larger quantities it was different. The observations of Mr. Homersham on the way in which water was stored in the chalk were most interesting, but, if this could not be got at, it was evidently wise to store what could be conveniently got at in the valleys. He would only say one word with reference to what Mr. Rawlin-

son had said on the question of the "compact." He thought the arrangements then made were very advantageous and desirable. If the water companies obtained large quantities of water from the river, which was to be brought into a proper condition, it was only right that they should contribute to the maintenance of that from which they derived this benefit. There was one larger question still in which many were interested, viz., the right of rivers to the water shed of the district. They had had that before them on a recent occasion with reference to the drainage of the Fens. There the water of the district had become essential to the maintenance of the rivers if navigation were to go on. In modern times, however, the question of navigation had become of less importance than drainage, although in an earlier stage of civilisation it might not have been so. Now that the main traffic of the country was carried on by means of railways—navigation, drainage, and water supply ought all to be kept distinct. The time was not far distant when, as they had seen with reference to the water shed of the Thames, the inhabitants of particular districts would become extremely jealous of water being transferred from one watershed to another. A river had a right to the water naturally belonging to it, and the inhabitants of the district had a right to the use of it; but, inasmuch as they benefited from that very use, why should they not be taxed for the maintenance of it in a proper condition? Those were questions upon which we were just entering; and he believed that the paper they had heard was one great step towards the solution of them. Those who knew what the state of the Thames was some years ago, when old London-bridge existed, and Lambeth was supplied with water drawn from the river between Waterloo and Westminster bridges, would see that anything which was paid for the privilege of drawing the water from beyond the tidal influence was money equitably levied. Tidal influence was in fact created by the removal of old London-bridge; and there being now a totally new state of things, the money paid for their advantage was rightly paid, for a good supply of water to the metropolis could not possibly be bought at too high a price.

ARTIZANS' VISITS TO PARIS.

At a meeting of the Council of the Birmingham Chamber of Commerce, held on Wednesday, the 29th ult., a letter was read from the Society of Arts, inviting the co-operation of the Chamber in sending skilled artizans to Paris, "to study the Exhibition and principal manufacturing establishments of France." Mr. W. C. Aitken, a member of the Society of Arts Committee for promoting the visits, was present by invitation, and explained the merits and advantages of the Artizans' Visits to Paris, as projected by the Society of Arts; he also pointed out that much benefit might be anticipated from the reports the artizans sent were bound to write, and the advantages an inspection of the factories and workshops the Society would afford them facilities of visiting; he also showed the advantages which might be expected to result to industries which the artizans sent represented—their reports being confined to objects in their own trade. After considerable discussion as to the best mode of furthering the objects, the following resolution, moved by the Mayor (Mr. George Dixon), and seconded by Mr. Blews, was agreed to unanimously:—"That the proposition of the Society of Arts, of sending skilled workmen to the Paris Exhibition, to report upon the productions exhibited is approved of, and that an application be made to the members of the Chamber, and the manufacturers of the town generally, asking them to subscribe to a fund for the purpose, and also to recommend qualified men for selection by the Society of Arts." The members present gave their names as subscribers.

Mr. W. C. Aitken has also addressed a letter to Mr.

John S. Wright, Vice-President of the Birmingham Chamber of Commerce, on the subject, from which the following are extracts:—

"Should the scheme be carried out it will be the Society of Arts Working Men's Excursion to Paris, the men selected to be sent being few in number, and representing the best, the most skilful and intelligent men engaged in the industries of our country. From Birmingham a selection should be sent of artizans engaged in the leading manufactures of the town. To defray their expenses contributions are solicited, and the intention in asking the Chamber of Commerce to co-operate is to give publicity to the movement, and receive contributions from its members individually, if the Chamber, as a body, has no funds at its disposal. The reports made by the artizans sent will be published, and thus become available, not only to manufacturers, but the general public; they will tell us alike of our strength and weakness, and of our vulnerable points. Whether the ideas entertained by the manufacturers of Birmingham about the Paris Exhibition are pleasing or not matters little; but one fact is certain—they have something to learn, and they have the means of learning it by sending a few of their best men to examine and report on the contents of the Paris International Exhibition. It should be known that other countries are more alive to progress than ourselves, and to each exhibition held in this country foreign artizans have been sent by the governments under which they lived. On the authority of Dr. Lyon Playfair, we are told that Continental and other countries, except our own, since the International Exhibition of 1862, have made rapid progress, which is visible in the products of industry exhibited at Paris, contributed by other competing countries. If such, then, is the case, as I believe it really is, it is the duty of English manufacturers to take every legitimate means to acquaint themselves of what has been done and is being done; and no method can be more legitimate and proper than through the instrumentality of artizans, intelligent and skilful, who, by practical experience, are able to and will detect differences which even their employers would pass over unheeded and unnoticed.

"Under the impetus given by exhibitions, the industries of Birmingham have been improved in their ornamental features, and the processes by which the articles have been produced have been facilitated and improved. Industrial education is now the order of the day in those countries which compete with us; the results of such teachings are manifested in the works exhibited. I am glad to say that among the students attending the Midland Institute of our town there are those whose habits of observation have been so quickened, their intelligence so educated, as to render them well fitted to visit and report on the contents of the Exhibition already named.

"I view the matter as a very important one, not lightly to be passed over. Gentlemen connected with your Chamber may differ from me as to its utility or not, but I am well convinced, from personal acquaintance with the manufactures of Birmingham, that every available means of getting information should be taken advantage of; and if what is seen is new and useful, it should be applied to and in the special industry it may be supposed to benefit.

"P.S.—Appended is the probable number of artisans engaged in Birmingham trades which it might be considered advisable to send:—

"Two artisans engaged in button making. One to report on the tool making; one to report on the ornament, style, and varieties of buttons exhibited.

"Two artisans engaged in brassfounding, to report on brass and bronze casting generally; cabinet, and general brassfounding; on bells, and plumbers' brassfounding; on rolled brass, wire, sheathing, tube making; on lamps, gas fittings, and naval brassfounding. One

to report on style and ornament; the other on quality and construction.

"One artisan engaged in the manufacture of electro-plate, or plated goods; to report particularly as to Russian products in silver work, and in reference to niello and enamels associated with works on the precious metals generally.

"One jeweller, to report also on gilt toys, chains, &c.

"One artisan engaged in the production of tools generally, who also has a knowledge of engineering connected with the construction of machines used in manufacturing.

"Two gunmakers.

"One japanner, acquainted with the processes of japanning, has artistic taste, and is also acquainted with the manufacture of papier maché; also to report if there are any substitutes for that material, and ascertain what they are.

"One stamper of metal, to examine as to the various processes employed in raising up thin sheet metal, as cornices and other stampings, &c.

"One steel-toy or edge-tool maker.

"One tin-plate worker, to report also on copper goods."

THE ALBERT HALL OF ARTS AND SCIENCES.

In reply to a letter in the *Times*, signed "Inquirer," Lieut.-Col. Scott, R.E., Secretary to the Provisional Committee, gives the following information in reference to this undertaking:—

"First, the Prince Consort did not state, as 'Inquirer' thinks, that 'no steps should be taken for the erection of the Hall of Arts and Sciences until the public had shown its sympathy with the proposal by subscribing £200,000,' but Her Majesty's Commissioners for the Exhibition of 1851 named £150,000 as 'the amount required to be raised by subscription before the public would be entitled to claim the benefit of the offer made by the Commissioners.'

"Secondly, as regards the popularity of the undertaking, the issue of the prospectus was commenced in the last week of November, 1865. By the end of January, 1866, £50,000 had been subscribed by the public, and in the April following this amount had risen to £100,000. The monetary panic soon afterwards induced the Provisional Committee to abstain from any further issue of the prospectus, but the success obtained in so short a time appeared to them to justify their acceptance of Messrs. Lucas's liberal offer to make up the subscription list to £150,000, and to take the contract for the works at ordinary trade prices. The Commissioners were also satisfied with these conditions, and consequently granted the site for the Hall, and guaranteed to take up sittings to the value of £50,000, in anticipation of a demand for them by the public.

"At present the subscription list stands thus:—The sum required for the undertaking is £200,000, and there has been subscribed by various persons £112,200, by Messrs. Lucas £38,000, and by Her Majesty's Commissioners £50,000; the sittings taken by Messrs. Lucas, as well as those taken by the Commissioners, being still at the command of the public.

"Thirdly, in reference to the 'curious fact' observed by 'Inquirer,' 'the total absence of the representatives of the numerous scientific societies of London' at the ceremony of laying the first stone of the Hall, I can vouch that, though his eyes failed to detect them in the vast assembly, invitations to the ceremony were accepted by the presidents of most of the leading scientific as well as artistic societies of the metropolis."

PARIS EXHIBITION.

It has been remarked, and with truth, that the British section of the exhibition is extremely unequal, some classes being fully represented, while others are sadly deficient; but the remark arises, in a great measure,

from the adoption of a false standard of comparison. Compared with other countries than France, England probably exhibits no more inequality than her neighbours. France is at home, and exhibits for her internal as well as external trade, and it is too much to expect manufacturers or merchants to take upon themselves the cost and trouble of exhibiting productions for which there is no market on the Continent. It is the business of governments and commissions to collect and show that which has only a general industrial, scientific, or artistic interest apart from commerce, and although there are some evident deficiencies, the Admiralty, the War-office, the South Kensington Museum, the Post-office, and other public establishments have done much to supply this desideratum.

Amongst the most remarkable omissions is that of the Transatlantic telegraph cable and its accessories. Since the last international exhibition no nation has achieved an act of higher practical difficulty, of larger results, or one which has obtained the same amount of admiration and applause; and it is certainly one of the strangest facts connected with this exhibition that the union of the old and new worlds by two electric cables should be totally without record on such an occasion.

Last week a short account was given of the contents of the first-class of the fifth group, mining and metallurgy; we will now visit the remaining classes of this group.

Class 41.—Forest products and the trades appertaining to them is very poorly represented, and this is not surprising, as it includes scarcely any articles of Continental demand; four exhibits of woods, veneers, and objects in wood; a collection of paper-making materials by W. H. Clarke, and one of fibres and woods of Mr. P. L. Simmonds, both of London, and illustrations of the late Capt. Fowke's experiments on timber, make up the whole list.

Class 42 is scarcely represented at all. Messrs. G. F. H. Clark and Co., of London, have, however, a good show of raw and manufactured resins and gums; and Mr. Ward a splendid case of stuffed birds.

Class 43—Agricultural products, not alimentary; this class is but little richer, there being only three exhibitors of wool, one of flax, &c., four of oils and grease, one of cigars, and one of compressed fodder.

Class 44—Chemical and Pharmaceutical products, is, on the contrary, not only fully but admirably represented; there are more than a hundred exhibitors in this class. The chemical and pharmaceutical exhibits proper number about thirty-five, and include many of the rarest products of, and some of the finest examples in the Exhibition of the chemicals of commerce. There are more than a dozen exhibitors of colours, dyes, and varnishes, who represent a very important branch of manufacture.

The starch manufacture is represented by four well-known firms—Berger and Co., Colman, Orlando Jones and Co., Beckett and Sons; and the beauty of the prisms and the admirable manner in which the products are exhibited call forth high praise. It should be mentioned, however, that Messrs. Berger have their chief show of this article in the food court.

There are more than half a dozen exhibitions of candles, wax, spermaceti, &c., and nearly as many of soap. The amount of science which has been brought to bear of late years in the manufacture of these articles, and their enormous importance in an industrial as well as general point of view, give great interest to this portion of the British section.

Class 45—Bleaching, dyeing, printing, &c., can scarcely be said to be represented at all.

Class 46 is also weak, but there are some very fine specimens of enamelled leathers.

The food group is closely allied to the preceding, but will be found in the outer zone of the building, with entrances from the great machinery court. It is perhaps on the whole the worst represented in the British side; it is lamentably deficient.

Class 67—Cereals, &c., can scarcely be said to be represented at all, and there are two or three exhibits of hops which would have been more in place in the fermented liquors class.

Class 68 includes four exhibitors of biscuits.

Class 69 is a blank. This is incomprehensible; English cheese is in great esteem in France; it is to be seen in all the best shops and at most restaurants. At the two cheese exhibitions held in Paris, every English exhibitor who has contributed has received a medal, yet there is not a single English cheese in the food department. An equally extraordinary omission occurs in the next class—meat and fish; while English ham and bacon are in constant demand in Paris, and while France and several foreign countries show those articles largely, there is not one exhibitor on the British side. Again, although the question of preserved meats has been so much discussed of late, and so many important experiments have been made towards applying the surplus meat of one hemisphere to the wants of the other, there are scarcely any indications of this on the British side of the exhibition. Mr. Morton has a good show of preserved provisions; Mr. Warriner shows two joints preserved raw; Messrs. Dufaville, Sanson, and Co. show a preparation of beef tea; meat preserved in paraffine is exhibited by Mr. Redwood's Company and by Mr. Young, and the *Extractum carnis* (Liebig) by Messrs. Allen and Hanburys, the two last-named being in the chemical class. Preserved fish is represented by one exhibitor, Mr. Austin, of Dublin, who shows a case of bloaters and another of sprats.

It is not surprising that the class of vegetables and fruit is empty; the few articles of this kind which England could show are included in the general collections of the next class—Condiments and stimulants—in which salt, mustard, pickles, extracts from spices, and other matters, are fairly represented. The last class in the group, that of fermented liquors, is represented by nine or ten ale-brewers, and a very few samples of cider, vinegar, whiskey, and cordials. These last two classes are, however, very largely represented at the Exhibition, for the articles shown in them are to be found at nearly every restaurant and buffet in the Champ de Mars.

THE PARIS EXHIBITION AND INDUSTRIAL EDUCATION.

The following letter appeared in the *Times* of the 29th ult. :—

SIR,—After the distribution of prizes at the London University this year, I made some remarks on the lessons which the late war in Germany and the present Exhibition at Paris afforded to us, if we wish to hold our own with other nations in the arts of peace and war.

I quoted a speech of the President of the Civil Engineers as to the superior progress made in machinery by foreigners. I spoke from the information which I had received from a gentleman intimately acquainted with the iron trade as to the greater improvements made in the manufacture of iron in France, Belgium, Germany, and Austria. It was only from general report that I stated the little advance we have made in most departments of industry, excepting those of furniture, glass, and china.

Since then I have seen the enclosed letter from Dr. Lyon Playfair. The subject is important, and his authority is great. I have therefore obtained his permission and that of Lord Taunton to ask you to publish it.

The inquiry of 1853, to which Dr. Playfair alludes, was chiefly owing to the information given him by the Prince Consort, than whom no one was more keenly alive to the want of generally-diffused scientific instruction in this country, or more active in stimulating all classes to remedy the defect.

I am, Sir, your obedient servant,
GRANVILLE.

16, Bruton-street, W., May 23.

FROM DR. LYON PLAYFAIR.

London, May 15, 1867.

My Lord,—As you desire that I should put in writing the substance of the conversation which I had the honour of having with your Lordship this morning, I willingly comply with your request.

I have just returned from Paris, where I acted as a juror in one of the classes of the Exhibition. In this capacity I had no other opportunities than any other juror of forming a judgment in regard to it; but, having had the charge of the working of the juries in the Exhibitions of 1851 and 1862, I naturally made the acquaintance of many eminent men of different nations, and, meeting with a large number of them congregated on the International Juries in Paris, I endeavoured to gather their opinions as to the position which England occupied in this great industrial competition.

I am sorry to say that, with very few exceptions, a singular accordance of opinion prevailed that our country had shown little inventiveness and made little progress in the peaceful arts of industry since 1862. Deficient representation in some of the industries might have accounted for this judgment against us, but when we find that out of 90 classes there are scarcely a dozen in which pre-eminence is unhesitatingly awarded to us, this plea must be abandoned. My own opinion is worthy only of the confidence which might be supposed to attach to my knowledge of the chymical arts; but when I found some of our chief mechanical and civil engineers lamenting the want of progress in their industries, and pointing to the wonderful advances which other nations are making; when I found our chymical and even textile manufacturers uttering similar complaints, I naturally devoted attention to elicit their views as to the causes. So far as I could gather them by conversation, the one cause upon which there was most unanimity of conviction is that France, Prussia, Austria, Belgium, and Switzerland possess good systems of industrial education for the masters and managers of factories and workshops, and that England possesses none. A second cause was also generally, though not so universally, admitted, that we had suffered from the want of cordiality between the employers of labour and workmen, engendered by the numerous strikes, and more particularly by that rule of many Trades' Unions, that men shall work upon an average ability, without giving free scope to the skill and ability which they may individually possess.

"Dumas, well known as a '*savant*,' and who, from his position as a senator of France and President of the Municipal Council, has many opportunities of forming a correct judgment, assured me that technical education had given a great impulse to the industry of France. In going through the Exhibition, whenever anything excellent in French manufacture strikes his attention, his invariable question is, 'was the manager of this establishment a pupil of the Ecole Centrale des Arts et Manufactures?' and in the great majority of cases he receives a reply in the affirmative. General Morin, so well known as the Director of the Conservatoire des Arts et Metiers, has lately sat on a commission to examine into the state of technical education in other countries, and to extend it in France, and he informed me that their recommendations were likely to be promptly and largely acted upon. I mention for your lordship's information that General Morin was of opinion that the best system for the technical education of workmen is to be found in Austria, though the higher instruction of masters and managers is better illustrated in France, Prussia, and Switzerland.

In 1853 I published a little work on "Industrial Education on the Continent," in which I pointed out that, as an inevitable result of the attention given to it abroad, and its neglect in England, other nations must advance in industry at a much greater rate than our own country. I fear that this result is already attained for many of our staple industries. But as my opinion is only that of an individual, I trust that it may accord with the objects of

the commission over which your Lordship presides to take the evidence of some of the leading jurors, many of whom had as good opportunities as myself of judging of the position which our country has taken in this great international competition.

Permit me also to make another suggestion. My inquiry of 1853 into industrial education on the Continent was a private one, and had neither official aid nor sanction, and is now antiquated. It would be important that the Government, either through your Commission or through the Committee on Education, should hold an official inquiry on this subject, and should tell the people of England authoritatively what are the means by which the great States are attaining an intellectual pre-eminence among the industrial classes, and how they are making this to bear on the rapid progress of their national industries.

My Lord, I have, &c.,
LYON PLAYFAIR.

The Right Hon. Lord Taunton.

In reply to Dr. Playfair's letter, the following communications, the first under the well-known signature of "Y," and the second by Dr. David S. Price, have likewise appeared in the *Times* :—

SIR,—In the letter of Lord Granville which you have published to-day is the following sentence:—"I spoke from the information which I had received from a gentleman intimately acquainted with the iron trade as to the greater improvements made in the manufacture of iron in France, Belgium, Germany, and Austria." Now, Sir, if this conclusion—namely, that greater improvements in the manufacture of iron have been made on the Continent than in this country, be drawn from the representation of that manufacture in the present International Exhibition in Paris, I assert that it is wholly fallacious, and for the plain and obvious reason that there is no representation properly so called of that manufacture in the French Exhibition. The reason for this is not far to seek. Our great practical metallurgists have now gained considerable experience as to the economic result of such Exhibitions to themselves, and the fact is "the thing does not pay." I know this from extensive correspondence with men who have figured prominently in that capacity at previous Exhibitions. Men engaged in the smelting and manufacture of metals are actuated by one object, and that is gain. It is only dreamers who imagine the possibility of other motives guiding the men of business in this country. Indeed, if it were otherwise, in these days of keen and constant competition, ruin would be inevitable. Were it necessary I could adduce examples of the actual pecuniary loss which has accrued to exhibitors of established reputation numerous enough to justify my assertion on this point.

But, Sir, Lord Granville's informant does injustice to his countrymen. It may be demonstrated that nearly all the great improvements in the smelting and manufacture of iron have been made in great Britain. Who invented puddling, whereby coal was made available for the conversion of pig-iron into malleable iron? Who invented grooved rolls, whereby the puddle-ball may, without the tedious process of hammering, be drawn out into bars? Who first succeeded in substituting coal for charcoal for the smelting of iron? Who suggested the hot blast, whereby great saving of fuel in the blast furnace is effected? Who introduced the process of casting steel? The credit of all these mighty improvements, for mighty indeed they are, is due to English and Scotch men. Such improvements are really epochs in the metallurgic industry of the world, and it is not to be expected that achievements of this magnitude will crop up in time for International Exhibitions occurring in such quick succession as of late. But, Sir, let me direct your attention to the invention of Mr. Bessemer, which dates from 1856, and which is only now acquiring its full development. That invention has already revolutionized the manufacture of iron throughout the world, and is of far greater

value to mankind than all the improvements in the manufacture of iron put together, of which France, Belgium, Germany, and Austria can boast, and Mr. Bessemer is an Englishman. It is a great invention, and if Great Britain had only produced one such in a century she would have maintained her rightful position in respect to improvements in the manufacture of iron. The products of that single invention, displayed in the Exhibition in London in 1862, may be regarded as of infinitely greater account than all the objects illustrative of iron metallurgic skill in the present exhibition in Paris, or, I may add, than all that have been shown in all the Exhibitions which have been held. And yet, forsooth, we are beaten by the iron manufacturers of the Continent in the sphere of improvement!

In particular and subordinate departments of the manufacture of iron we are, doubtless, excelled, and that, too, where dexterity of manipulation is largely concerned, as in the rolling of girders. But let the demand for such girders be increased, and we shall produce them you may be assured. Only a very few years ago the demand for large armour-plates was created. Who has supplied that demand? And is it not the fact that mills have been constructed in England which regularly turn out sound plates of such enormous dimensions as even in 1860 would have been considered impossible? Where else are such plates manufactured? Yet we are beaten in the manufacture of iron!

There is another point which should be noted. It is that great improvements may occur in the smelting of iron or other metals which cannot be illustrated in Exhibitions. Thus, suppose a modification in the inner form of a blast furnace, in its relative dimensions, in the composition of the charge, and in the mode of driving, as it is termed, whereby equally good pig-iron can be made cheaper than heretofore. That, Sir, you will admit, must be an important improvement. It is true a model and a few specimens of the pig-iron ticketed with the price might be sent; but they would not more adequately represent the improvement, in an Exhibition sense, than a description of it on a piece of paper. They would not appeal to the eye like a large girder, a massive ingot of steel, or an enormous armour-plate. And since 1862 we have certainly effected improvements in that direction. You will bear in mind that some weeks ago I privately placed this view of the matter before you.

In conclusion, Sir, I think I may say, without the charge of egotism, state that, like Lord Granville's informant, I also have had the opportunity during many years of carefully watching and becoming intimately acquainted with the state of the iron manufacture on the Continent of Europe as well as America, and I have no hesitation in expressing my conviction that we have no reason to be disheartened as to our position with respect to that great industry. I would neither croak nor exult. If there be cause for misgiving, it will be found in the unreasonable and mischievous machinations of paid Trades' Union agitators, who may, unhappily, succeed in diverting capital from the mills and forges of England to those of foreign countries.

I am, Sir, your obedient servant,

May 29.

Y.

SIR,—In justice to British inventiveness, disparagingly alluded to in the *Times* of to-day, it is right that attention should be drawn to a very important fact—namely, that the greatest discoveries in applied chymical science of the last 20 years, and possibly of the present age, have been made in this country and by Englishmen.

To those conversant with industrial progress it will scarcely be necessary for me to state that I allude to the Bessemer process and to the aniline dyes, popularly known as the coal-tar colours. It is not for their discovery only that we are indebted to Englishmen, but for their industrial development also. At Paris these new branches of industry, the future influence of which upon trade can scarcely be foreseen, are not represented by

those who have had the greatest share in their development, while in the foreign courts beautiful series of specimens, for the knowledge of the production of which the exhibitors are mainly indebted to British skill, are displayed to the greatest possible advantage.

In 1862 Mr. Bessemer made a magnificent exhibition of what his process could effect. At Paris in 1867 he is content to let other men and many nations show how and with what success they have adopted his process. No aniline dyes are exhibited by our manufacturers, although it is well known that they are the first in the world. It will, therefore, be seen that it is very difficult for the public to draw any inference as to the state of these two important manufactures in England from what they find exhibited at Paris. Whether, in a national point of view, it would have been right to see that our country was correctly represented in her industries, and an erroneous impression as to her skill rendered impossible, is a matter upon which I need not enter.

Dr. Playfair, in his letter to Lord Taunton, recommends that further inquiries should be made into the educational systems of the Continent. Should the suggestion be adopted, I would venture to advise that an inquiry of equal importance for the success of industrial progress should be coupled with it, and that is, as to the working of the Patent Laws in France and Germany and the relations existing between inventor and manufacturer, which it is much to be regretted are not well understood here.

I have the honour to be, Sir, your obedient servant,

DAVID S. PRICE.

26, Great George-street, Westminster, May 29.

Commerce.

THE COTTON TRADE.—Mr. Sam Mendel's circular for the 1st June, says that the continued high cost of cotton, compared with the prices ruling for yarns and goods, still leaves the millowner in a very unenviable and unsatisfactory position, and it is only by some decided improvement in our home-trade consumption, or by a reduced production, that relief can be looked for. From the first-named source, there has been, within the last few days, some indication of amelioration, and it is to be hoped that this will not only continue but increase to an extent that will serve to diminish the recent and still-continued heavy exports to India. Fortunately, the Indian markets have proved to be in a healthy and strong position, from previous short supplies and the better condition of the native population to consume the fabrics from this district. Yet it is now becoming an anxious question as to how far supplies can continue without producing depletion.

Colonies.

QUEENSLAND IMPORTS AND EXPORTS.—The total value of the imports and exports of the colony of Queensland from and to each country during 1866 was as follows:—

	Imports.	Exports.
Great Britain....	£ 742,884	£ 321,939
Australia.....	1,711,895	1,025,377
New Zealand....	—	2,541
Germany.....	3,921	—
India.....	—	3,630
Ceylon.....	—	14
Java.....	9,059	12,752
Miscellaneous..	148	253
	£2,467,907	£1,366,506

The sum of £421,325, which is laid out in foreign markets, chiefly English, for the supply of apparel and drapery goods, is equal to one-half of the whole annual export of wool; and the money that goes out of the colony in payment of the freight on these goods is no

inconsiderable sum. At present the colony exports the staple for the fabric of most of the clothing required, and in return it gets woollens and cottons of very inferior descriptions. Every man, woman, and child spends the sum of £9 annually in clothing.

BOWEN, A NEW SETTLEMENT IN QUEENSLAND, has now a population of about 1,500. This is another instance of the speedy rise of colonial towns, and of one which has not received an impetus from any extraneous cause, as the exports up to the present time have been confined to pastoral produce only. The value of imports in 1866 amounted to £78,200; exports, £42,437. Since the settlement of Bowen, the country to the northward has been steadily taken up by squatters, so that a new comer cannot obtain any land between this and the Gulf of Carpentaria, unless he pushes out to the westward. Notwithstanding the tropical climate, sheep and cattle do very well with ordinary care and management. The whole is being most rapidly stocked. The increase on the whole is very satisfactory. Considerable excitement exists regarding gold at Bowen just now. A small party have been at work for months past, whose object was supposed to be working of copper, which is said to exist in the neighbourhood. There has of late been a suspicion that a more valuable metal than copper has been attracting them, and this has proved to be the case, as the parties have come forward to ask a reward for the discovery of a suitable gold field, of which Bowen will be the port, the distance being about 100 miles, with a good road. Bowen has the advantage of a most superior harbour and magnificent bay, a harbour which is only surpassed in the colonies by that of Sydney. There is also the advantage of an extensive jetty, alongside of which steamers and vessels of moderate draught can now lie, and which, by a little extension, could be made available for any ordinary merchantman.

Notes.

AERONAUTICAL EXPERIMENTS IN FRANCE.—A scientific commission, including members of the French Institut, the Observatory, and the College of France, has just been formed for the purpose of drawing up a programme of experiments to be carried out with M. Nadar's great balloon, the *Géant*, and a smaller one called the *Cylindre*. Amongst the members of this commission are—MM. Regnault, president; Sainte Claire-Deville, Marie-Davy, and Sourel, of the Observatory; Laussedat, of the Ecole Polytechnic, and Renon. The Reverend Father Secchi, director of the Roman Observatory, now in Paris, and who exhibits a very ingenious electro-magnetic meteorological register, has offered his services to the commission. It is expected that the great capacity of the *Géant* will allow more complete experiments being carried out than has hitherto been possible; instruments are being prepared, and the first ascent is announced to take place from the park of the Exhibition, in a few days. It is not yet known who is to conduct the experiments.

NATIONAL MONETARY CONFERENCE.—It is said that the French Government has invited the European powers to attend a conference to be held in Paris on the 17th instant, to take into consideration the question of an international system or arrangement, and that England, Portugal, Spain, Belgium, and Switzerland have promised their co-operation.

MEETINGS FOR THE ENSUING WEEK.

MON.....R. United Service Inst., 8½. Vice-Admiral G. Elliot, "On the Hydraulic Propeller as a Motive Power for Ships."

TUES ...R. Medical and Chirurgical, 8½
Photographic, 8.
Ethnological, 8. 1. Mr. F. Boyle, "On the Free Indian Tribes of Central America." 2. Mr. J. Crawford, "On the History and Migration of Cultivated Plants in reference to Ethnology—Spicerias." 3. Col. Phayre, "On the Tenure and Distribution of Landed Property in Burma."

- R. Horticultural, 3. General Meeting.
 WED ...Microscopical, 8.
 R. Literary Fund, 3.
 R. Society of Literature, 8½. Dr. C. M. Ingleby, "On the Unpublished Manuscripts of Samuel Taylor Coleridge." Archaeological Assoc., 8½.
 THUR ...Syro-Egyptian, 7½. Dr. Camps, "On the Demoniacs, or possessed, mentioned in Holy Scripture. Were they Epileptic?"
 FRIAstronomical, 8.
 R. United Service Inst., 3. Capt. H. Barber, "The Organisation of the Indian Army."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Delivered on 29th May, 1867.

- Par. Numb.
 168. Bill—Tyne Pilotage Act (1865) Amendment.
 170. „ Houses of Parliament (amended).
 171. „ Metropolitan Police.
 292. Constabulary (Cornwall)—Return.
 303. Lighting and Buoying (Ireland)—Return.
 308. Navy (Iron Ballast)—Report of Dr. Percy.
 312. Postal Services (India and China)—Return.
 326. Public Works Loan Commissioners—Return.
 Public Petitions—Twenty-sixth Report.

Delivered on 30th May, 1867.

158. Bill—Petit Juries (Ireland) (amended).
 169. „ National Gallery Enlargement (amended).
 306. Justices of the Peace—Return.
 320. Military Savings Banks—Account.

Delivered on 31st May, 1867.

166. Bill—Municipal Corporations (Metropolis).
 173. „ British White Herring Fishery.
 46. (rv. Trade and Navigation Accounts (30th April, 1867).
 309. Slave Trade—Return.
 325. Corrupt Practices at Elections—Returns.

Delivered on 1st June, 1867.

172. Bill—Public Works Loans.
 174. „ Mines, &c., Assessment (amended).
 324. Army (Gun Factories)—Balance Sheets (1861-62).
 329. Limited Liability Acts—Report.
 331. Population of Counties—Return.
 Jamaica—Further Correspondence.
 Public Petitions—Twenty-seventh Report.

Delivered on 3rd June, 1867.

175. Bill—Vaccination (amended).
 315. West India Mails—Return.
 316. West Indian Mails—Return.
 317. Superior Courts of Law—Return.
 332. Revenue and Population—Return.

Delivered on 4th June, 1867.

176. Bill—Limerick Harbour (Composition of Debt) (amended).
 298. Shannon and Suck Rivers—Report of Mr. J. Lynam.
 309. John Carroll—Memorials.
 311. Copper, &c.—Return.
 327. Military Knights of Windsor—Statutes.
 Luxembourg—Treaty.
 Luxembourg—Protocols of Conferences.
 Luxembourg—Correspondence respecting the Grand Duchy.

Patents.

From Commissioners of Patents' Journal, May 31st.

GRANTS OF PROVISIONAL PROTECTION.

- Axle-boxes, &c.—1429—A. V. Newton.
 Axles—1404—J. Watkins.
 Beer-engines—1490—H. A. Dufrené.
 Belts, ladies'—167—J. M. Stanley.
 Boilers—1401—J. Steven.
 Boilers—1419—E. Field.
 Book-rest—1482—E. O. and W. T. Hallett.
 Breaks, coupling—1373—T. A. Weston.
 Breaks, railway—1420—J. Clark.
 Brick-making machines—1393—W. Clark.
 Buffer springs—1369—T. A. Weston.
 Cards, &c.—1402—T. Nelson.
 Cartridge holders—1413—J. Leetch.
 Cartridges—1381—G. Jeffries.
 Cartridges—1484—W. E. Gedde.
 Case, medical instrument—372—E. A. Kirby.
 Casters—1406—W. R. Lake.
 Charcoal, revivification of—1415—W. Cormack.
 Coffee pot—1375—T. Brown.
 Collars for horses, &c.—1343—R. Smith.
 Cutlery—1101—E. Stevens.
 Cutlery—1359—J. Nixon and J. Winterbottom.
 Egg beater, &c.—1374—T. Brown.
 Egg boilers—1424—B. Barrett and H. Mackenzie.

- Engines, rotary—1383—F. B. Döring.
 Evaporators—1416—W. E. De Bourran.
 Explosive compounds—1345—W. E. Newton.
 Fabrics—1298—S. Thacker.
 Fibrous materials—1466—G. Bernhardt.
 Fire-arms, breech-loading—1339—W. W. Greener.
 Fire-escapes, &c.—1418—M. D. Rogers and J. Wilson.
 Fishing apparatus—1331—S. E. Hallett.
 Fishing apparatus—1333—S. E. Hallett.
 Food, mixing—1385—R. Mellard.
 Furnaces—1409—J. G. N. Alleyne.
 Gas, &c.—1272—P. Salmon.
 Gun barrels, boring—1400—J. Piddington.
 Gunpowder—1408—G. A. Neumeyer.
 Heat, transferring—1478—H. A. Dufrené.
 Hoops, wooden—1341—E. Faucher.
 Iron, &c., welding—1377—W. E. Newton.
 Lead, white—1464—W. R. Lake.
 Levels—1218—J. W. Cochran.
 Locks, &c.—1353—H. J. Saxby.
 Looms—1387—A. Cooper.
 Looms—1414—C. Eastwood.
 Looms—1468—E. Webb.
 Looms—1488—J. Bottomley.
 Lubricators—1337—J. Booth.
 Metal cocks, &c.—1407—W. R. Lake.
 Metals, &c., preparing—1411—G. Lunge.
 Musical instruments—1280—J. Smyth and S. Kirby.
 Oils, extraction of—1472—T. Richardson.
 Paper presses—1365—R. and A. Wood.
 Paving—1476—B. Sheil.
 Pianos—1376—A. Herce.
 Printing machines—1361—T. J. Mayall.
 Ranges—1305—R. Russell.
 Scales—1397—J. Walker.
 Sewing machines—1399—G. Browning.
 Sewing machines—1410—R. H. Padbury.
 Sewing machines—1462—J. Smith.
 Ships' propellers—1423—C. Randolph.
 Ships, &c., toy—1367—A. Fournier.
 Shuttles—1480—J. Smith and J. L. Ibbotson.
 Signals, railway—1422—A. H. Colles.
 Textile materials, bleaching—1403—W. Clark.
 Trowels—1321—J. Ball.
 Valves—1335—E. Bourdon.
 Water-closets—1371—J. Bowden.
 Water-closets—1426—J. G. Jennings.
 Winding machines—1357—J. Gaskell.
 Winding machines—1391—J. Combe.
 Windlasses—1428—E. Walker.
 Wood, working—1366—S. W. Worssam.
 Wool, &c., combing—1363—G. E. Donisthorpe.
 Yarns—1405—J. W. Dalby and F. Constantine.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

- Motive-power apparatus—1575—H. A. Bonneville.
 Stone-dressing machines, &c.—1566—W. Snell.
 Wool, weaving—1577—H. A. Bonneville.
 Wool, &c., carding—1576—H. A. Bonneville.

PATENTS SEALED.

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|-----------------------|-------------------------|
| 3162. H. Bateman. | 3240. W. H. Biggleston. |
| 3165. S. J. Browning. | 3261. T. H. Cooper. |
| 3179. J. A. Coffey. | 3336. M. Henry. |
| 3194. J. M. Worrall. | 3354. W. E. Newton. |
| 3199. V. Vandroy. | 68. J. Silvester. |
| 3200. J. Toward. | 224. H. A. Bonneville. |
| 3204. F. Palmer. | 914. W. Wood. |
| 3207. W. Clark. | |

From Commissioners of Patents' Journal, June 4th.

PATENTS SEALED.

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| 3195. C. E. Brooman. | 3236. W. Robertson and C. J. Waddell. |
| 3196. R. and H. Harild. | 3265. S. Chatwood. |
| 3201. H. F. Swears. | 3288. H. Brinsmead. |
| 3210. R. Duncan. | 3295. C. Randolph. |
| 3215. J. Darling. | 3297. S. Chatwood & J. Sturgeon. |
| 3218. R. Ackroyd and W. Maud. | 3299. G. Bertram. |
| 3220. F. W. Turner. | 3316. M. Weber. |
| 3226. A. C. Fraser. | 3367. M. Weber. |
| 3229. W. A. Richards. | 42. J. V. y Jové. |
| 3230. J. McGlashan. | 94. A. H. Brandon. |
| 3231. R. Smith and J. Ramage. | 345. S. Howard. |
| 3234. H. C. Lucy. | 1153. W. Harrison. |
| 3235. T. Chaloner & J. Billington. | |

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

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| 1326. J. Dickson. | 1384. W. E. Newton. |
| 1352. W. and S. Firth. | 1394. G. Coles, J. A. Jaques, and J. A. Fanshawe. |
| 1541. H. Phillips. | |
| 1373. R. A. Brooman. | |

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

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| 1336. W. E. Newton. | 1357. C. W. Lancaster, J. Brown, and J. Hughes. |
| 1337. W. R. Bowditch. | 1408. G. A. Waller. |